

Constellation-X Mission Requirements

- Goal for FY00 is to establish a complete, firm set of **top level requirements** and to flow them down to subsystems in a **derived requirements document** and associated **error budgets**. Also update **Reference Mission Description** to reflect new requirements.
 - As of last year (June 99) we had a combined top level/derived requirements document which contained most, but not all, program requirements, plus preliminary error budgets.
 - Decided to split the single combined requirements document into separate top level and derived requirements documents.
 - Top level document has been split off and updated, plan to baseline in March.
 - Will update derived requirements document fully by June, but need to assess impact of new top level requirements sooner (Feb)

“New” Top Level Requirements

- **Detector Backgrounds:** TBD
- **Spectral Accuracy and Stability:** $< 25\%$ of wavelength(energy) resolution
- **Photometric Accuracy and Stability:** Absolute flux to $< 10\%$ and relative to $< 5\%$
- **Bright Source Capability:** 10000cts/sec point source, 10000 cts/sec over detector field
- **Extended Source Capability:** The stated spatial and spectral resolutions shall be maintained over the telescope field of view.
- **Timing Resolution and Precision:** 40 μ sec resolution and 100 μ sec precision
- **Targets per Day:** 5 targets per day
- **Real Time Observing:** Not required
- **Data Latency:** Data available 72 hours after completion of observation
- **Data Downlink:** TBD
- **Data Storage:**TBD

Impacts of New Requirements

- **Detector Backgrounds:** Provide X-ray shielding for instruments, eliminate stray light and use optical blocking filters, maximize rejection of cosmic rays via shape discrimination and provide anti-coincidence shield for micro-calorimeter. Requirement will focus attention on this area but will not add to cost or complexity.
- **Spectral Accuracy and Stability:** Grating/CCD design requires 0th order image chips to eliminate effects of pointing knowledge errors. Careful thermo-elastic design of CCD and grating/SXT to provide stable wavelength scale. Calorimeter will need onboard calibration source(s) and periodic calibration measurements. May cross-calibrate the CCD/grating with the calorimeter (in the energy overlap region) on an astronomical source. Need to address HXT.
- **Photometric Accuracy and Stability:** Calibrate detector QE's in lab and then perform on-orbit calibrations using known sources from Chandra or XMM (i., e. CRAB, EO 102, G21.5). Raytrace code will also help, and perhaps limited ground measurements of single shells.
- **Bright Source Capability:** Calorimeter and calorimeter electronics design must accommodate the 10,000 cts/sec requirement (either from a focussed point source with 15 arcsec HPD or from an extended source across the FOV). Average science telemetry downlink rate of 48kbps is OK provided enough onboard storage is available for short observations at higher peak rates. Current peak rate of 1365kbps is OK. Need to define observation plan to size storage requirement.

Impacts of New Requirements(cont)

- **Extended Source Capability:** Effects of 1.25 arc-min off-axis angle must be included in SXT error budget for 15 arcsec HPD (negligible impact). Spectral resolution of calorimeter must not degrade at edges of FOV. Not applicable to Grating/CCD.
- **Timing Resolution and Precision:** Similar to XTE, but at L2 as opposed to LEO. GSFC experts think that it is achievable. Study underway now to identify hardware.
- **Targets per Day:** Derive requirements on slew rate, star acquisition time and settling time. Initial values are 180 deg in 45 min (240 arcsec/sec avg) plus 3 minutes to acquire stars and settle.
- **Real Time Observing:** No impact, but must consider coverage for critical initial operations.
- **Data Latency:** This is a major impact on ground system.
- **Data Downlink:** Current design allows for 48kbps average science data rate (+4kbps engineering data rate). Requirement should conform to this with no problem.
- **Data Storage:** Current design allows for 2 days storage at average daily rate (about 9.5 Gbits). Need to re-evaluate this based on the 10,000 cts/sec requirement and projected observation plans.